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(71) Applicant (for all designated States except US): AVANTEGO AB [SE/SE]; Box 511, S-184 25 Åkersberga (SE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): BJÖRKMAN, Tony [SE/SE]; Norrövägen 22, S-184 42 Åkersberga (SE). SJÖHOLM, Jan [SE/SE]; Malmskillnadsgatan 47B, S-111 38 Stockholm (SE).

(74) Agent: GÖTEBORGS PATENTBYRÅ DAHLS AB; Sjöporten 4, S-417 64 Göteborg (SE).

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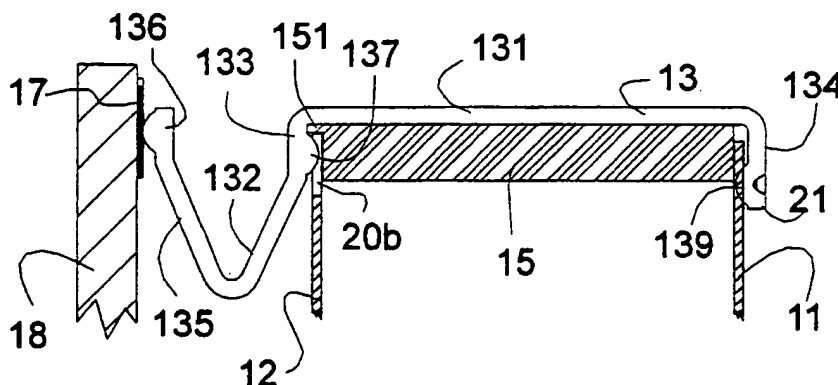
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ANTENNA ARRANGEMENT



(57) Abstract: The invention refers to an antenna arrangement (10) of the type that comprises an antenna element (11) arranged spaced apart from a ground plane (12) and provided with at least one feeding connector element (13) and at least one ground connector element (14, 14'). At least one of said connector elements (13, 14, 14') has a first and a second contact surface (137, 139; 147, 149) and said element is attached to said antenna element (11) and the ground plane (12) such that at least one of said first and second contact surfaces apply a contact pressure on at least one of the antenna element (11) or the ground plane (12) and hold together said antenna element (11) or the ground plane (12).

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## TITLE

## ANTENNA ARRANGEMENT

## 5 TECHNICAL FIELD OF THE INVENTION

The present invention relates to an antenna arrangement of type that comprises a ground plane spaced apart from an antenna plane for use in a mobile communication device. The invention also concerns a method of manufacturing and mounting the same.

10

## BACKGROUND OF THE INVENTION

In an antenna, e.g. of PIFA (Planar Inverted F Antenna) type or a ground and a radiator element arranged spaced apart, in a communication device, such as a cellular phone, a Bluetooth-based (short range transmission standard) device or the like a critical parameter is the connection between the feeding and earth connectors to the antenna element and ground plane, respectively, and to the connections from the circuitry.

To obtain a good connection, usually one of the antenna element or the feeding element is plated with an inert metal, such as gold or the like, to avoid oxidation problems. However, the plating with gold is a costly and time-consuming operation, which highly depends on the form of the antenna, included elements and so on.

European Patent Application No. 851 531 discloses an antenna assembly comprises an antenna a circuit board and components, and means for covering the circuitry whilst also retaining the antenna in physical connection to the circuit unit when the antenna and the circuit unit are brought together. Additionally, this device cover and retaining means takes the form of a deformable electrical coupler which provides an electrical coupling between the antenna and the circuit unit when the antenna and the circuit unit are brought together. The antenna is fixed via its ground region to the cover, and this cover engages with lower member and sprung pin when the antenna unit is compressed onto the circuit unit. The cover and lower member are electrically conductive and make the ground connection between the antenna and the circuit. The sprung pin makes the

electrical feed connection to the antenna. The cover and retaining means may also act as a shielding device.

In US 6,025,802 a new category of mobile communications antenna is implemented in a single layer of conducting material. Wire-slot sections, including wire-tabs defining slots in the material, partially extend around the perimeter of at least one patch-tab section of the antenna. The perimeter of the at least one patch-tab section forms one edge of each slot, and the wire-tab of a wire-slot section forms a second edge of the slot. The wire-tabs of the wire-slot sections are separated from the patch-tab section by the slots and merge into the patch-tab section at a desired point. The length of each of the wire-slot sections may vary. A portion of each of a pair of the wire-tabs of the wire-slot sections functions as an input feed. The patch-tab section may be implemented as a single tab or as a plurality of tabs separated from one another by a slot. By varying the relative geometries of the patch-tab, wire-slots and tabs of the wire-slots, the electrical properties of the antenna, including the input impedance, can be adjusted.

US 5,657,028 discloses a module (1') adapted for insertion into a data processor (2). The module includes an interface (40) for electrically coupling the module to the data processor, a modem (42) that is bidirectionally coupled to the interface, an RF energy transmitter (44) having an input coupled to an output of the modem, an RF energy receiver (46) having an output coupled to an input of the modem, and a partially shorted, dual C-patch antenna (20) that is electrically coupled to an output of the RF energy transmitter and to an input of the RF energy receiver. The partially shorted, dual C-patch antenna is comprised of a truncated ground plane (22), a layer of dielectric material (28) having a first surface overlying the ground plane and an opposing second surface, and an electrically conductive layer (30) overlying the second opposing surface of the dielectric layer. The electrically conductive layer forms a radiating patch and has a rectangularly shaped aperture having a length that extends along a first edge of the electrically conductive layer and a width that extends towards an oppositely disposed second edge. The length has a value that is equal to approximately 20% to approximately 35% of a length of the first edge. The antenna further includes electrically conductive vias or feedthroughs (24) for shorting the electrically conductive layer to the ground plane at a region adjacent to a third edge (20a) of the electrically conductive layer. In a presently preferred embodiment of this invention the module is a wireless communications PC card having dimensions of approximately 8.5 cm x 5.4 cm by 0.5 cm, and is

thus form and fit compatible with a PCMCIA Type II PC card.

The above mentioned documents fail to show an antenna and a connector arrangement according to the invention.

5

## SUMMARY OF THE INVENTION

The main object of the present invention is to provide an antenna, which is easy to manufacture and mount inside a communication device.

10

The connectors, i.e. the connecting elements establishing connection between the antenna element and a feeding point, and the ground and the ground plane, in the antenna of the invention are easy to manufacture and provide with a protective layer, which provides an inexpensive antenna simplifies the assembly of the antenna.

15

The antenna according the invention has a modular structure, which allows easy variation of the antenna depending on the communication device, needs and requirements.

20

Therefore, in the initially mentioned antenna arrangement, at least one of said connector elements has a first and a second contact surface and said element is attached to said antenna element and the ground plane such that at least one of said first and second contact surfaces apply a contact pressure on at least one of the antenna element or the ground plane and hold together said antenna element or the ground plane.

25

In most preferred embodiments said at least one connector element is arranged as a clip or clasp and are substantially S or U-shaped.

30

Preferably, said substantially S-shaped ground connector element is provided with a connection point at one end to said antenna element, a connection point to said ground element and a connection point to a grounding point at another end. Moreover, said substantially S-shaped feed connector element is provided with a connection point at one end to said antenna element and a connection point to a feeding point at the other end.

In one embodiment, a spacer means is provided between said antenna element and ground plane and the spacer is provided with a blocking means distancing said feed connector element from the ground plane to provide isolation between the feeding element and the ground plane.

- 5 It is also possible to provide ground plane connected to a ground through an auxiliary connector, which is part of a shielding arrangement.

According to a method of the invention for arranging an antenna arrangement comprising an antenna element arranged spaced apart from a ground plane and provided with at least one feeding  
10 connector element and at least one ground connector element steps of: providing at least one of said connector elements loosely, and attaching said connector element between said antenna element and the ground plane to provide a contact pressure on at least one of the antenna element or the ground plane, are provided.

- 15 The invention also concerns a communication arrangement comprising an internally arranged antenna device, comprising an antenna element arranged spaced apart from a ground plane and provided with at least one feeding connector element and at least one ground connector element. At least one of said connector elements, provided loosely, is attachable between said antenna  
20 element and the ground plane to provide a contact pressure on at least one of the antenna element or the ground plane. The arrangement may be a cellular phone or a Bluetooth-based device.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- In the following, the invention will be further described in a non-limiting way under reference to  
25 the accompanying drawings in which:

- Fig. 1 is a schematic top view of a preferred embodiment of an antenna according to the present invention,  
Fig. 2 is a cross-section along line A-A in fig. 1,  
30 Fig. 3 shows a magnified view of the encircled section in fig. 2,  
Fig. 4 is a cross-section along line B-B in fig. 1, illustrating a first embodiment,  
Fig. 5 shows a magnified view of the encircled section in fig. 4,

Fig. 6 is a cross-section along line B-B in fig. 1, illustrating a second embodiment, and  
Fig. 7 shows a magnified view of the encircled section in fig. 6.

#### DETAILED DESCRIPTION OF THE EMBODIMENTS

5

Referring to figs 1-5, reference sign 10 denotes an antenna arrangement, comprising an antenna element 11, a ground plane 12, connector elements 13 and 14, and a spacer 15.

10 The antenna element 11 is a dual or multi band antenna consisting of a conductive sheet provided with a substantially longitudinal and vertical slit 16. However, the slits 16, if arranged, may have other shape and location on the antenna element. In case of a single band antenna, the slit 16 can be eliminated.

15 The connector elements are arranged as substantially S-shaped clips or clasps (figs. 2 and 3). Clearly, the shape of the clips is not limited to S-shape and can be varied. The connector element 13 is arranged to connect the antenna element 11 to a feed point 17 on a PCB 18. The connector element 14 is arranged to connect the ground plane 12 and antenna element 11 to a grounding point 19 on the PCB 18. The feed and grounding points can be connected to the sender/receiver circuitry (not shown) of the communication device.

20

Taking the connector clip 13 (figs. 2-3), as a common example for both connector elements, it comprises a first end 21 (22 for clip 14 (figs. 4-5)) connecting to the antenna element 11. The clip, as mentioned above is substantially S-shaped, having a first section 131 (fig. 3) and a second section 132. The first section 131 comprises two substantially parallel portions 133 and 134, also  
25 substantially parallel to the antenna element 11 and ground plane 12. The distance between said first and second portions corresponds to the spacer 15. The second portion is substantially "nose"-shaped having an inclining section 135, which ends in a connector end 136. The portion 133 is arranged with a bulging 137. The clip is connected to the antenna element 11, at the end section 21 through an extension 139, which extends inside a groove on the antenna element. The end 21  
30 can be fixed in place by means of a rivet, a weld, conductive adhesive, etc. By prearranging the grooves on the antenna element 11, it is possible to obtain a distinct distance between the ends 21 and 22 of the clips, which effects the antenna characteristics.

The ground clip 14 is shaped similar to connector 13 and similar reference signs (14x instead of 13x, x referring to a part sign) are adhered to it.

5 The ground plane 12 is provided with at least one opening 20a, such that it allows the bulging section 147 (fig. 5) of ground connector clip 14 to contact the edges of it. The feeding connector clip 13 (fig. 3) is, however, isolated from the ground plane 12 through another opening 20b in the ground plane 12. Therefore, the spacer 15 is provided with an extension 151, on which some part of the section 133 bears against, which distances it from the ground plane 12. It is also possible to isolate the clip 13 from the ground plane 12 in other ways, e.g. through an isolation layer,  
10 rearranging the resilient part 132 between the ground and antenna element and having a larger hole 20b, which also can provide an antenna with less height.

Thus, the shapes of the clips can make them resilient and allow essentially resilient but secure contact between the end of the clips 136 (not shown 146 for clip 14) and the connection points 17  
15 and 19, respectively, when the antenna is mounted inside the communication device and fixed by means of fixing arrangement or due to pressure from the bottom and lock of the housing.

On the PCB 18, for example under the antenna 10, as shown in fig. 2, shielded arrangements, comprising a grounded conductive box 30 for shielding circuits (not shown) can be arranged.

20

Fig. 6 is an embodiment corresponding to a cut through the antenna device according to fig. 1 along line B-B and similar to fig. 4. The difference is that the parts of ground clip 14 in fig. 4, which connect to earth point on the PCB are eliminated. The clip 14' according to this embodiment is a substantially U-shaped part connecting between the antenna element and the ground plane.

25 Clearly, the shape of the clips is not limited to U-shape and can be varied. The ground plane 12 is connected to ground through a pin shaped part 31 prying from the shielding box 30 and resiliently connecting to the ground plane.

Accordingly, the antenna has a modular structure comprising of parts which can be manufactured  
30 separately and assembled together with regard to the communication device design, frequency requirements etc.; for example, the location of the connector clips can be varied to obtain required antenna features, the form of the antenna element can be varied for obtaining single or multi-band

characteristics while same ground plate is used and so on..

The invention is not limited the shown embodiments but can be varied in number of ways without departing from the scope of the appended claims and the arrangement and the method can be  
5 implemented in various ways depending on application, functional units, needs and requirements  
etc.



## CLAIMS

1. An antenna arrangement (10) of the type that comprises an antenna element (11) arranged spaced apart from a ground plane (12) and provided with at least one feeding connector element (13) and at least one ground connector element (14, 14'),

*characterized in*

that at least one of said connector elements (13, 14, 14') has a first and a second contact surface (137, 139; 147, 149 ) and said element is attached to said antenna element (11) and the ground plane (12) such that at least one of said first and second contact surfaces apply a contact pressure on at least one of the antenna element (11) or the ground plane (12) and hold together said antenna element (11) or the ground plane (12).

2. The arrangement of claim 1,

*characterized in*

that said at least one connector element is arranged as a clip or clasp.

3. The arrangement of claim 2,

*characterized in*

that said clip (13, 14) is substantially S-shaped.

4. The arrangement of claim 2,

*characterized in*

that said connector element (14') is substantially U-shaped.

5. The arrangement of claim 3,

*characterized in*

that said substantially S-shaped ground connector element (14) is provided with a connection point at one end to said antenna element, a connection point to said ground element and a connection point to a grounding point at another end.

6. The arrangement of claim 3,

*characterized in*

that said substantially S-shaped feed connector element (13) is provided with a connection point at one end to said antenna element and a connection point to a feeding point at the other end.

7. The arrangement of claim 3,

5 *characterized in*

that a spacer means (15) is provided between said antenna element and ground plane.

8. The arrangement of claims 6 and 7,

*characterized in,*

10 that said spacer is provided with a blocking means (151) distancing said feed connector element from the ground plane.

9. The arrangement of claim 4,

*characterized in,*

15 that said ground plane is connected to a ground through an auxiliary connector (31').

10. The arrangement of claim 9,

*characterized in,*

that said auxiliary connector (31') is part of a shielding arrangement (30').

20

11. A method of arranging an antenna arrangement comprising an antenna element (11) arranged spaced apart from a ground plane (12) and provided with at least one feeding connector element (13) and at least one ground connector element (14, 14'),

*characterized by,*

- 25 – providing at least one of said connector elements (13, 14, 14') loosely, and  
– attaching said connector element between said antenna element (11) and the ground plane (12) to provide a contact pressure on at least one of the antenna element (11) or the ground plane (12).

30 12. A communication arrangement comprising an internally arranged antenna device (10), comprising an antenna element (11) arranged spaced apart from a ground plane (12) and provided with at least one feeding connector element (13) and at least one ground connector element (14,

14'),

*characterized in,*

that at least one of said connector elements (13, 14, 14'), provided loosely, is attachable between said antenna element (11) and the ground plane (12) to provide a contact pressure on at least one  
5 of the antenna element (11) or the ground plane (12).

13. The communication arrangement of claim 12,

*characterized in,*

that it is a cellular phone.

10

14. The communication arrangement of claim 12,

*characterized in,*

that it is a Bluetooth-based device.

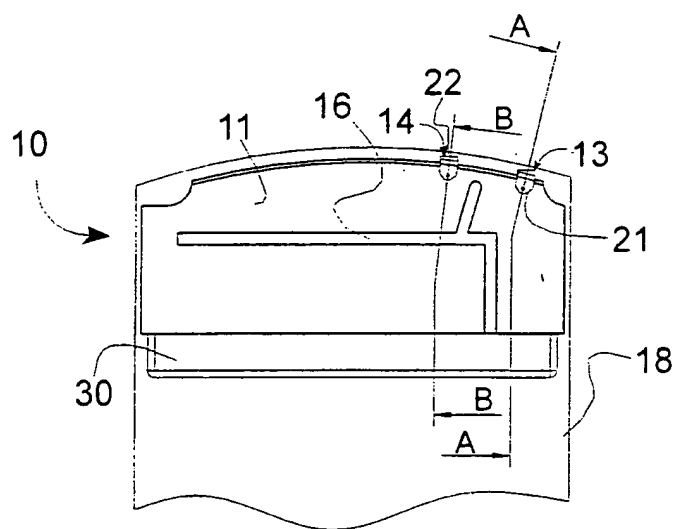
15 15. A connector arrangement (13, 14, 14') for use in an antenna arrangement (10), which comprises an antenna element (11) arranged spaced apart from a ground plane (12), said connector arrangement being arranged to connect said antenna element (11) to said ground plane (12),

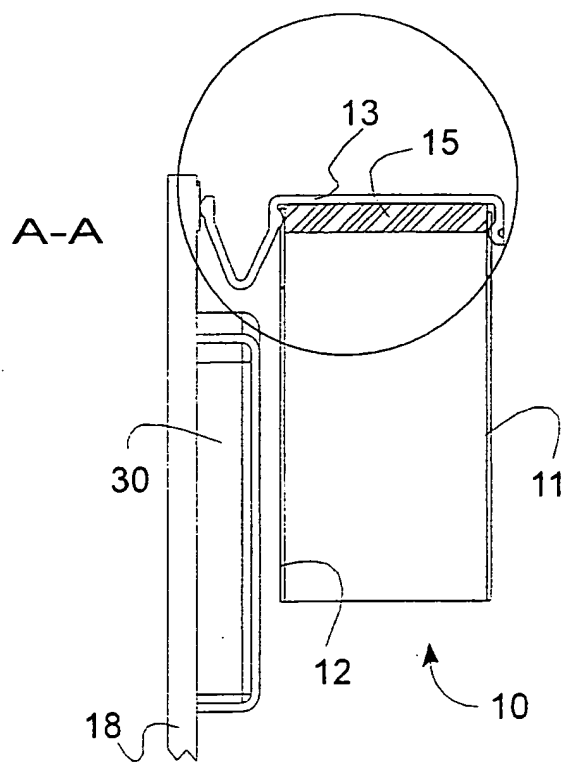
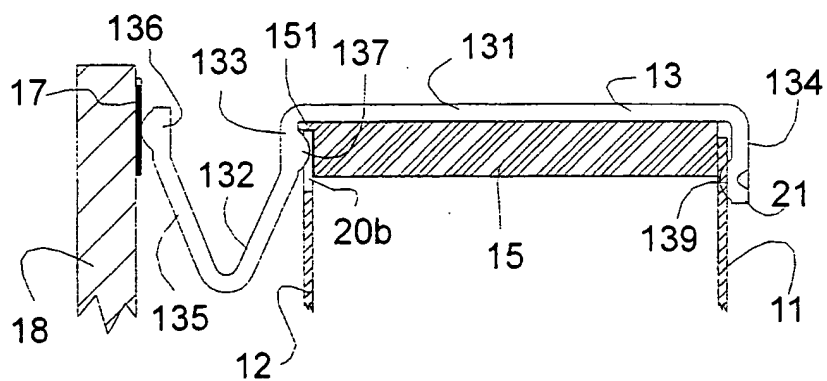
*characterized in*

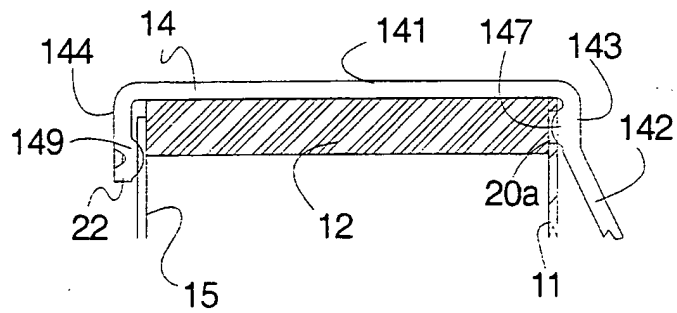
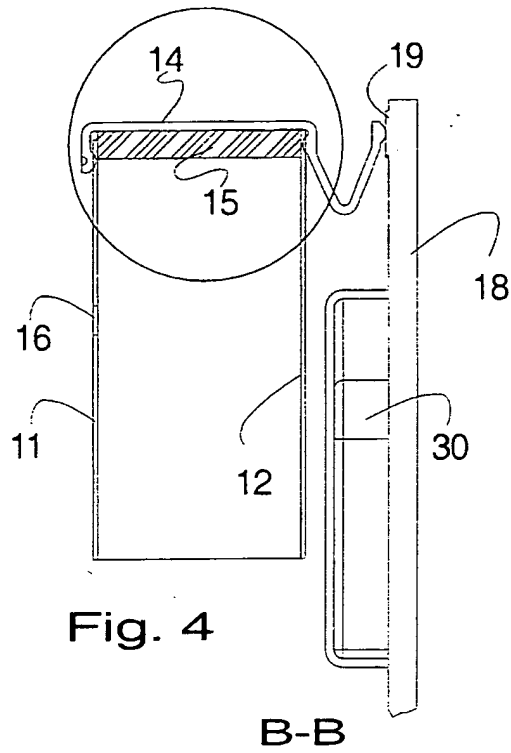
that said connector element (13, 14, 14') at least partly is substantially U-shaped and arranged with  
20 a first and a second contact surface (137, 139; 147, 149) and connects said antenna element (11) and the ground plane (12) such that at least one of said first and second contact surfaces apply a contact pressure on at least one of the antenna element (11) or the ground plane (12) and hold together said antenna element (11) or the ground plane (12) spaced apart.

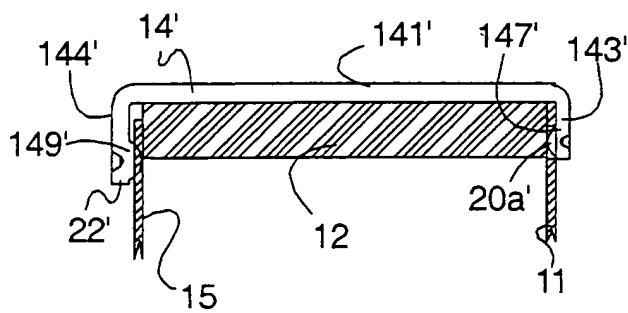
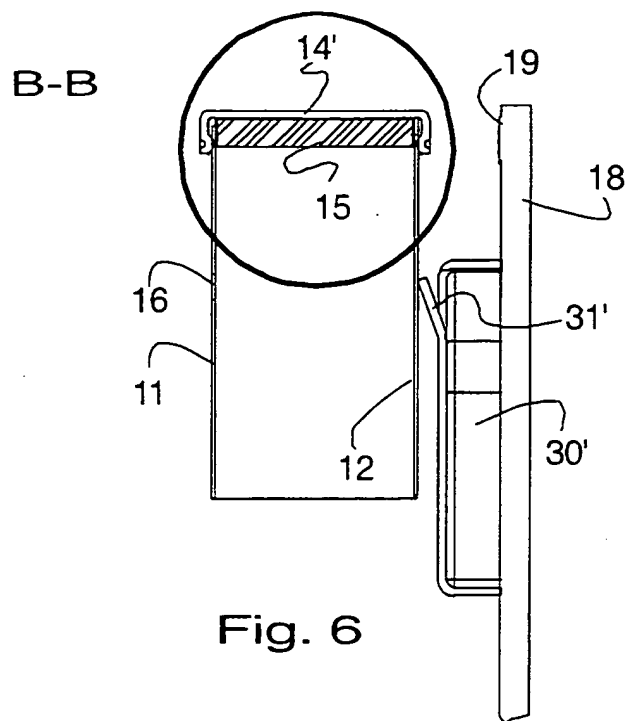
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30

**Fig. 1**

**Fig. 2****Fig. 3**





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/00702

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01Q 1/24, H01Q 1/48

According to International Patent Classification (IPC) or to both: national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01Q, H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	--	4
X	US 5781158 A (YOUNG HOEK KO ET AL), 14 July 1998 (14.07.98), column 2, line 2, figure 1	15
A	--	4



Further documents are listed in the continuation of Box C.



See patent family annex.

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## INTERNATIONAL SEARCH REPORT

International application No.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT  
Information on patent family members

28/05/01

International application No.

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